NOTICE

All drawings located at the end of the document.

Administrative Record STARR Meeting Minutes
August 7, 1997

1. Location and time of Meeting: Bldg. 460, Room 163N, 11:00am

2. Attendees:
Ann Sieben, K-H
Susan Myrick, RMRS
Jan Marshall, RMRS
Jan Robbins, RMRS
Norma I. Castaneda, DOE

3. Jan Marshall distributed copies of the Administrative Record File Index for OU2 Buffer Zone; IHSS Code 108. The group is to review the file index for Trench T-1 for completeness. Castaneda will send copies to Gary Kleeman, Environmental Protection Agency (EPA), Carl Spreng, Colorado Department of Public Health and Environment (CDPHE), and Laura Brooks, Kaiser-Hill. Everyone is to review the file index as soon as possible. If there is anything missing, please let Jan Marshall know immediately.

4. Documents and letters for the Administrative Record will be sent for microfiche process within the following week.

5. This Trench T-1, IHSS 108 file index, was a revision from the OU2 Buffer Zone index file. This OU2 Buffer Zone index file was distributed to Castaneda and Sieben.

6. Castaneda will receive the responses from the EPA and CDPHE, and will forward the responses back to Jan Marshall.

7. The last document that will be needed for the Trench T-1 index file is a letter from the EPA approving the Trench T-1 Proposed Action Memorandum (PAM).

8. These meeting minutes will also go in the Trench T-1 index file.

2-0000 67595

ER/WM&I DDT

Source/Driver: (Name & Number from ISP, IAG milestone, Mgmt. Action, Corres. Control, etc.)	Closure #: (Outgoing Correspondence Control #, if applicable)	N/A Due Date

S. Paris / M. C. Broussard
Originator Name

G. D. DiGregorio
QA Approval

for A. M. Tyson
Contractor Manager(s)

Ann K. Sieben
Kaiser-Hill Program Manager(s)

T. G. Hedahl
Kaiser-Hill Director

Document Subject:

TRANSMITTAL OF THE SAMPLING AND ANALYSIS PLAN (SAP) FOR THE SITE CHARACTERIZATION AT THE 903 DRUM STORAGE AREA (IHSS 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE; AND 903 DRUM STORAGE AREA (IHSS 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE DATA SUMMARY - AMT-109-97

KH-00003NS1A September 22, 1997

Discussion and/or Comments:

Please find enclosed eight copies of the Sampling and Analysis Plan (SAP) for the Site Characterization at the 903 Drum Storage Area (IHSS 112), 903 Lip Area (IHSS 155), and Americium Zone document (one copy for Kaiser-Hill, two copies for the DOE, two copies for the EPA, two copies for the CDPHE , and one copy for the Administrative Record). Also enclosed is one copy of the 903 Drum Storage Area (IHSS 112), 903 Lip Area (IHSS 155, and Americium Zone Data Summary with color maps for your reference (copy was submitted to you earlier with the draft SAP).

If you have any questions regarding these documents, please contact Annette Primrose at extension 4385 or Steve Paris at extension 3656 of my staff.

Enclosures:
As Stated

cc:
M. C. Broussard w/o attach.
A. C. Crawford "
J. Law "
S. M. Paris "
A. L. Primrose "
Administrative Record
RMRS Records

KAISER•HILL
COMPANY

RMRS Rocky Mountain Remediation Services, L.L.C.
...protecting the environment

SAMPLING AND ANALYSIS PLAN FOR THE SITE CHARACTERIZATION AT THE 903 DRUM STORAGE AREA (IHSS 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE

RF/RMRS-97-084

September 18 1997
Revision 0

SAMPLING AND ANALYSIS PLAN FOR THE SITE CHARACTERIZATION AT THE 903 DRUM STORAGE AREA (IHSS 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE

Rocky Mountain Remediation Services, L.L.C

September 18, 1997

Revision No. 0
Document Control No: RF/RMRS-97-084

SAMPLING AND ANALYSIS PLAN
FOR THE
SITE CHARACTERIZATION
AT THE
903 DRUM STORAGE AREA (IHSS 112), 903 LIP AREA (IHSS 155), AND AMERICIUM ZONE

RF/RMRS-97-084

Prepared By:

Rocky Mountain Remediation Services, L.L.C.

Rocky Flats Environmental Technology Site
Golden, Colorado

September 18, 1997
Revision 0

Project Manager _____ Date_____

Quality Assurance _____ Date_____

Classification Review _____ Date_____

Industrial Hygiene _____ Date_____

Radiological Engineering _____ Date_____

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LIST OF ACRONYMS

APO	Analytical Projects Office
ALF	Action Level Framework
bgs	Below Ground Surface
CDH	Colorado Department of Health
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cm	Centimeters
DOE	Department of Energy
DNAPL	Dense Non-Aqueous Phase Liquid
DQO	Data Quality Objective
EA	Exposure Area
EMD	Environmental Management Department
EPA	Environmental Protection Agency
ERM	Environmental Restoration Management
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FO	Field Operations
FOV	Field Of View
GT	Geotechnical
GPS	Global Positioning System
HPGe	High Purity Geranium
IDM	Investigative Derived Material
in	Inches
IHSS	Individual Hazardous Substance Site
K-H	Kaiser-Hill
LDR	Land Disposal Restriction
m	Meters
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
NAPL	Non-Aqueous Phase Liquid
OU	Operable Unit
OVM	Organic Vapor Meter
pCi/g	Picocuries Per Gram
ppb	Parts per Billion
ppm	Parts per Million
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PID	Photoionization Detector
QAPD	Quality Assurance Project Description
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RF	Rocky Flats
RFI/RI	Resource Conservation and Recovery Act Facilities Investigation/ Comprehensive Environmental Response, Compensation and Liability Act Remedial Investigation
RFCA	Rocky Flats Cleanup Agreement

LIST OF ACRONYMS (Cont.)

RFEDS	Rocky Flats Environmental Database System
RFETS	Rocky Flats Environmental Technology site
RMRS	Rocky Mountain Remediation Services
ROD	Record of Decision
ROI	Radiological Operations Instructions
RPD	Relative Percent Difference
RPT	Radiological Protection Technician
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TCLP	Toxicity Characteristic Leaching Procedure
UCL	Upper Confidence Limit
ug/L	Micrograms per Liter
VOC	Volatile Organic Compound

STANDARD OPERATING PROCEDURES

NUMBER	PROCEDURE TITLE
5-21000-OPS-FO.3	Field Decontamination Procedures
4-S02-ENV-OPS-FO.04	Decontamination of Equipment at Decontamination Facilities
5-21000-OPS-FO.6	Handling of Personal Protective Equipment
5-21000-OPS-FO.7	Handling of Decontaminated Water and Waste Water
4-K56-ENV-OPS-FO.08	Handling and Containerizing Drilling Fluids and Cuttings
4-K55-ENV-OPS-FO.10	Receiving, Marking and Labeling Environmental Containers
5-21000-OPS-FO.11	Field Communications
5-21000-OPS-FO.12	Decontamination Facility Operations
4-B29-ER-OPS-FO.14	Field Data Management
5-21000-OPS-FO.13	Containerization, Preserving , Handling , and Shipping Soil and Water Samples
5-21000-OPS-FO.16	Field Radiological Measurements
4-F99-ENV-OPS-FO.23	Management of Soil and Sediment Investigative Derived Materials (IDM)
4-B11-ER-OPS-FO.25	Shipment of Radioactive Samples
5-21000-OPS-GT.01	Logging Alluvial and Bedrock Material
5-21000-OPS-GT.02	Drilling and Sampling Using Hollow-Stem Auger Techniques
5-21000-OPS-GT.05	Plugging and Abandoning Boreholes
4-E42-ER-OPS-GT.08	Surface Soil Sampling
5-21000-OPS-GT.10	Borehole Clearing
5-21000-OPS-GT.25	Approval Process for Construction Activities on or Near Individual Hazardous Substance Sites (IHSSs)
4-S64-ER-GT.39	Push Subsurface Soil Sample
4-61100-REP-1401	Operation of Gamma Ray Spectroscopy Systems
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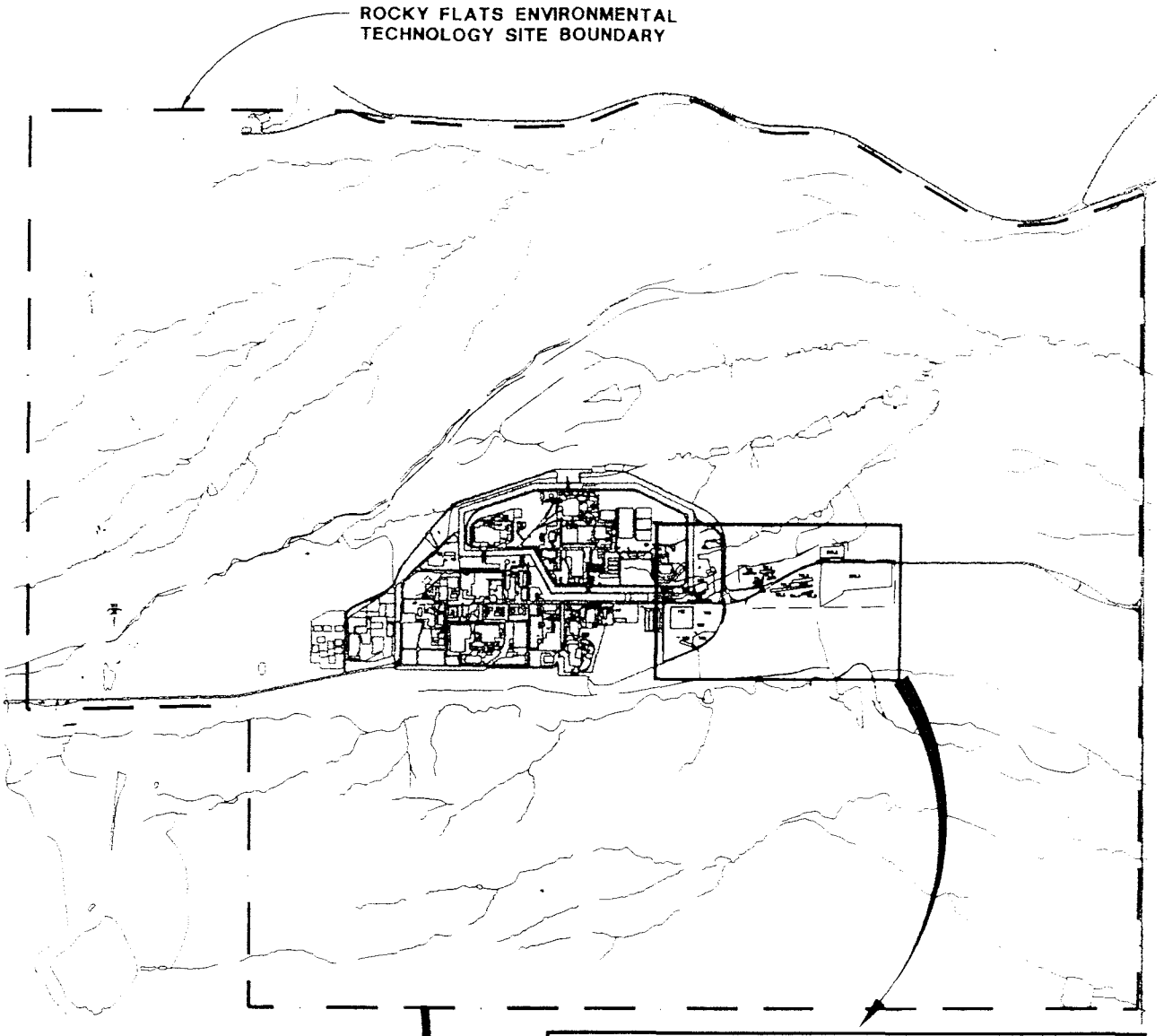
1.0 INTRODUCTION

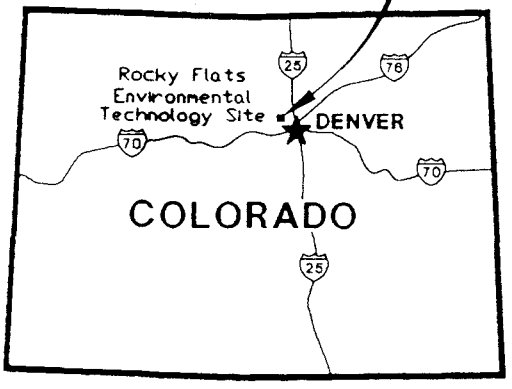
The purpose of this sampling and analysis plan (SAP) is to identify and delineate the spatial and vertical extent of soils exceeding the Rocky Flats Environmental Technology Site (RFETS) Cleanup Agreement (RFCA) Action Level Framework (ALF) Soil Tier I Action Levels at the Individual Hazardous Substance Site (IHSS) 112 - 903 Drum Storage Site (903 Pad), IHSS 155 -903 Lip Area (Lip Area) and Americium Zone surface soils. Implementation of this SAP will provide better definition of the extent of contamination at the site and further delineate the volume of soils requiring remediation. Figure 1.1 provides the locations of the IHSSs and the Americium Zone. The overall goal of this sampling program is to determine the location, area, and volume of soils requiring remediation.

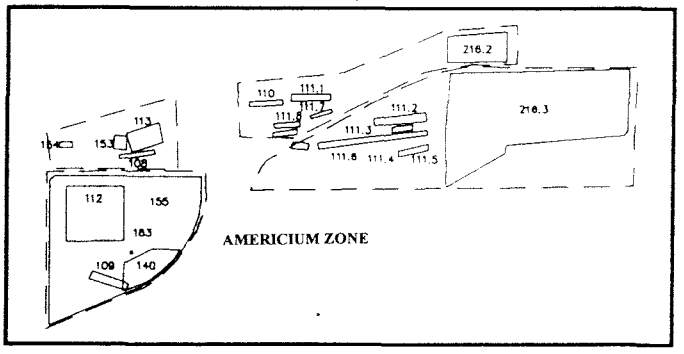
Previous investigations have been conducted in these areas to determine the extent of contamination, specifically the OU2 Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigation (RFI/RI) (DOE, 1995). However, previous surface soil investigations were designed and implemented to characterize exposure areas (EAs) of 2.5- and 10-acres. Because these EAs are considered too large for a remedial alternative evaluation (i.e. the extent needs to be refined), this SAP targets characterizing surface soil contamination with a EA of 1,217 ft^2 (113 m^2 or 2.8×10^{-2} acre).

Previous investigations into organic contamination at the 903 Pad have not detected volatile organic compound (VOC) concentrations in subsurface soils above RFCA Tier I action levels. However, evaluation of groundwater data collected at and downgradient of the 903 Pad indicate the presence of a non-aqueous phase liquid (NAPL) source. Contaminants previously detected in groundwater are dense non-aqueous phase liquids (DNAPL). This suggests that a DNAPL source is present in the area but has not been detected during previous investigations. As a result this SAP targets areas known to have high concentrations of VOCs in groundwater.

In 1996 the Actinide Migration Expert Panel was formed to review existing data on actinide migration at RFETS and make recommendations for future work. Their recommendations included activities to:







PREPARED FOR

U.S. DEPARTMENT OF ENERGY

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

FIGURE 1.1
SITE LOCATION MAP

SAMPLING AND ANALYSIS PLAN
FOR THE
CHARACTERIZATION
OF THE
903 PAD, 903 LIP AREA AND AMERICIUM ZONE

1. Develop a conceptual model for actinide transport, based on a thorough understanding of chemical and physical processes;
2. Investigate the long-term impacts of actinide geochemistry mobility on remedial requirements; and
3. Evaluate the protectiveness of the RFCA soil action levels to surface water quality.

Based on the results of Actinide Migration Expert Panels evaluation, revisions to this SAP may be warranted.

1.1 Background

Releases at the 903 Drum Storage Site (IHSS 112) are considered the primary source of radiological contamination in the surficial soil in this part of RFETS. Drums that contained radioactively-contaminated oils and VOCs were stored at this location from the summer of 1958 to January 1967. Approximately three fourths of the drums contained plutonium-contaminated liquids while most of the remaining drums contained uranium-contaminated liquids. Of the drums containing plutonium, the liquid was primarily lathe coolant and carbon tetrachloride in varying proportions. Also stored in the drums were hydraulic oils, vacuum pump oils, trichloroethene, percloroethylene, silicone oils, and acetone still bottoms (DOE, 1995).

Leaking drums were noted in 1964 during routine handling operations. The contents of the leaking drums were transferred to new drums, and the area was fenced to restrict access. When cleanup operations began in 1967, a total of 5,237 drums were at the drum storage site. Approximately 420 drums leaked to some degree. Of these, an estimated 50 drums leaked their entire contents. The total amount of leaked material was estimated at around 5,000 gallons of contaminated liquid containing approximately 86 grams of plutonium (DOE, 1995).

From 1968 through 1970, some of the radiologically contaminated material was removed, the surrounding area was regraded, and much of the area was covered by an imported base coarse material and an asphalt cap. However, during drum removal and cleanup activities, wind and rain

spread plutonium-contaminated soils to the east and southeast from the 903 Pad area resulting in IHSS 155 (903 Pad Lip Area). Several limited excavations have removed some of the plutonium contaminated soils from the Lip Area (DOE, 1995)(Barker, 1982). However, results from the OU2 Phase II RFI/RI sampling and analysis confirm that radiologically contaminated soils remain.

Surface soils to the east and southeast of the Lip Area also exhibit elevated plutonium-239/240 and americium-241activities. This contamination is primarily attributed to wind dispersion from the 903 Pad with potential contributions from historical fires and stack effluent. Areas exhibiting elevated plutonium-239/240 and americium-241 activities east and southeast of the Lip Area are know as the Americium Zone.

1.2 Existing Data

Numerous investigations to assess the extent of contamination at the 903 Pad, Lip Area, and Americium Zone have been conducted. These investigations are briefly described below.

1.2.1 Surface Soils

High Purity Germanium (HPGe) Surveys - HPGe surveys conducted in 1990 (EG&G, 1991) and 1994 (RMRS, 1996) provide useful information on the activity of americium-241 in surface soils over the Americium Zone study area. These data were collected on a 150 foot grid to accommodate the HPGe detector's field of view (FOV) of 150 feet in diameter (17,671 ft^2). Surveys were not conducted over the 903 Pad and Lip Area and soil samples were not collected to supplement the surveys. The results from these surveys are being utilized to define the boundaries of this characterization's study area.

Surface Soil Radiological Data - Surface soil samples were collected in support of the OU2 Phase II RFI/RI (DOE, 1995). As detailed in the RFI/RI, samples were collected utilizing two sampling methods; the CDH sampling method and the RF sampling method. Surface soil sample results were compared with RFCA Tier I surface soil action levels. The results of the comparison indicated that samples collected from five 2.5-acre plots exceed the Tier I action levels. These plots include two

2.5-acre plots (Plots 28 and 34) sampled using the CDH sampling method and three 2.5-acre plots (Plots 29, 36, and 46) sampled using the RF method.

1.2.2 Subsurface Soils

Subsurface Soil Radiological Data - Three data sources were evaluated to determine the depth of radiological contamination within the study area: 1) RFI/RI borehole data (DOE, 1995); 2) RFI/RI soil profile pits (DOE, 1995); and 3) samples collected in support of a 1980 soil decontamination project (Rutherford, 1981). Results from the RFI/RI borehole samples were compared to RFCA action levels revealed that no samples exceed the Tier I soil action levels for radiological contaminants. However, samples collected from soil profile pit TR08 exceeded Tier I action levels to a depth of 27 centimeters (cm) (10.6 inches[in]). Soil profile pits were sampled at 3 cm (1.2 in) intervals to a total depth of 1 meter (m) (3.28 feet). Samples collected at soil profile pit TR06, located adjacent to pit TR08, were not analyzed because activities exceeded the DOT shipping requirements. It is assumed that radiochemical results from pit TR06 would also exceed Tier I action levels, if analyzed.

Soil samples collected beneath the 903 Pad in support of the 1980 soil decontamination project exceeded Tier I action levels to a depth of 66 cm (26-inches). This depth exceeds the thickness of the asphalt pad (3 in) and the depth of imported basecoarse material (8 in) and indicates radiological contamination of natural undisturbed soils at the 903 Pad. However, no RFI/RI soil borings detected radiological contamination in excess of Tier I action levels. As a result, a discrepancy with the depth of radiological contamination between these investigations exists.

Subsurface Soil VOC Data - Three sources of data were evaluated to determine the nature and extent of contamination at the 903 Pad: 1) RFI/RI borehole data (DOE, 1995); 2) IM/IRA soil gas survey results (DOE, 1994); and 3) groundwater monitoring well data.

Borehole sample results from the RFI/RI were compared with RFCA Tier I soil action levels revealed that no samples exceeded action levels for organic contaminants. The soil gas survey indicated that the highest VOC concentrations were located immediately south of the southeast corner of the 903

Pad. Tetrachloroethene was detected at 27,000 ug/L at a depth of 5 feet. However, at adjacent soil gas locations and boreholes, tetrachloroethene is either not detected or detected at very low concentrations. Soil gas concentrations for the remaining portion of the 903 Pad ranged from 0 -500 ug/L with the highest concentrations around boreholes 08691 and 08891.

1.2.3 Groundwater

A VOC-contaminated groundwater plume extends from the 903 Pad area to the east. The highest concentrations are found in groundwater samples collected from wells 06691 and 08891 located on the asphalt portion of the 903 Pad. Concentrations of contaminants in groundwater decrease rapidly moving eastward from the 903 Pad area. This decrease in concentration may be a result of the hydraulic dispersivity reflected in the distance between the two wells locations. The primary groundwater contaminant in well 06691 is carbon tetrachloride with concentrations ranging from 51 to 100,000 parts per billion (ppb). Methylene chloride (150 to 35,000 ppb) and chloroform (92 to 49,000 ppb) are also observed. Groundwater sample results for well 08891 indicate the primary contaminant as tetrachloroethene at concentrations ranging from 470 to 20,000 ppb, along with carbon tetrachloride (290 to 17,000 ppb), cis-1,2,dichloroethene (94 to 2,900 ppb) and trichloroethene (210 to 4,600 ppb). The next highest concentration of carbon tetrachloride in groundwater is found in samples collected from well 13191, which is located west of the well 06691 and off the western edge of the 903 Pad. At this location, observed carbon tetrachloride levels ranged from 122 to 4,800 ppb.

Because of the complex nature of DNAPL transport and fate, DNAPL may often be undetected by direct methods leading to incomplete site assessments and inadequate remedial designs (EPA, 1992). A guide for estimating the potential for a DNAPL source at a site includes assessing if concentrations of DNAPL-related chemicals in groundwater are greater than 1% of the pure phase solubility of the DNAPL compound (EPA, 1992).

Table 1.1 provides a comparison of the pure phase aqueous solubility and concentrations of DNAPL-compounds detected in groundwater at or near the 903 Pad. The comparison indicates that tetrachloroethene and carbon tetrachloride have been detected in groundwater samples at 10% and

12% of their aqueous solubilities, respectively. Based on the results of this comparison and known historical site uses, there is a high potential of organic contaminants at the 903 Pad site.

TABLE 1.1 COMPARISON OF PURE PHASE AQUEOUS SOLUBILITY WITH CONCENTRATIONS IN GROUNDWATER SAMPLES - SELECTED VOCs

COMPOUND	PURE PHASE AQUEOUS SOLUBILITY AT 25°C[1] (mg/L)	HIGHEST CONCENTRATION DETECTED IN GROUNDWATER (mg/L)	RATIO GROUNDWATER/ AQUEOUS SOLUBILITY (%)
Carbon Tetrachloride	793	100.0	12.6
Chloroform	7,920	49.0	0.62
cis-1,2,dichloroethene	3,500	2.9	0.83
Methylene Chloride	13,000	35.0	0.27
Tetrachloroethene (PCE)	200	20.0	10.0
Trichloroethene (TCE)	1,100	4.6	0.42

1 EPA, 1996. Soil Screening Guidance: Technical Background Document

Radionuclide contamination in groundwater was investigated by reviewing groundwater monitoring well sample results from 1991 to 1995 in wells identified as containing VOC contamination as discussed above. Groundwater analytical data indicate that groundwater in one well, 09091, located on the 903 Pad, contains americium-241 and plutonium-239/240 activity in excess of Tier I action level for groundwater. Tier I action levels for americium-241 and plutonium-239/240 are 14.5 pCi/L and 15.1 pCi/L, respectively. This well has produced groundwater samples with maximum activities of 354.6 pCi/L of americium-241and 46.54 pCi/L of plutonium-239/240. Uranium isotopes have not been detected in excess of their respective background activities in groundwater samples collected over this period.

1.3 Site Conceptual Model

The surficial geology in the study area consists of Quaternary alluvium, colluvium and slump deposits along with artificial fill, soil and debris deposits, and disturbed soil. The surficial deposits overlie bedrock which consists of weathered claystone and minor bedrock sandstones of the Cretaceous Arapahoe and Laramie Formations. Surficial deposits consist of sandy clay and clayey gravel. Soil developed over the alluvium is rocky and sandy in contrast to the clayey soils developed over the claystone bedrock.

Artificial fill is present directly beneath the 903 Pad and in the Lip Area as a result of previous remediation activities. In November 1968 "slightly contaminated" soil was graded from outside the fence at the 903 Pad into the fenced area to be capped. In September of 1969 a basecoarse material overlay, soil sterilant, and asphalt primer were constructed for the 903 "containment barrier" (Pad). The asphalt pad was constructed in October of 1969 and is reportedly to be 3 in (7.6 cm) thick. The thickness of the basecoarse materials beneath the 903 Pad is assumed to be approximately 8 inches (20 cm) . In February 1970, operations were initiated to apply additional fill (basecoarse) over the Lip Area due to soil contamination. This fill material ranges from 0.8 in (2 cm) to 5.1 in (13 cm) (DOE, 1995).

The surficial soil contaminants of concern are plutonium-239/240 and americium-241. Plutonium-239/240 is relatively insoluble and tends to be strongly sorb to fine grained soil particles. While there is a tendency for plutonium-239/240 and americium-241 activities to decrease with increasing distance from the source areas, several areas outside of the 903 Pad and Lip Area show higher activities. This distribution is not typical of wind disbursement and reflects other factors including surface water run-off. The OU2 RFI/RI (DOE, 1995) states that 90% of the americium-241 and plutonium-239/240 activities are concentrated in the upper 6 in (15 cm) of the soil.

Subsurface soil contaminants of concern include carbon tetrachloride, tetrachloroethene, trichloroethene, americium-241 and plutonium-239/240. Organic contaminant concentrations detected in groundwater indicate that a DNAPL may be present beneath the 903 Pad area. The exact location of the DNAPL has not been identified from previous investigations including boreholes and

soil gas vapor studies. It is unknown if the DNAPL has remained in the soil pore space as residual contamination or is present on the bedrock surface.

Figure 1.2 provides a conceptual model of the 903 Pad Site. The model presents a worst case scenario with a complex DNAPL pathway in both the vadose and saturated zones and with a pooled mobile DNAPL phase resting on bedrock.

2.0 DATA QUALITY OBJECTIVES

The data quality objective process consists of seven distinct steps and is designed to be iterative; the outputs of one step may influence prior steps and cause them to be refined. Each of the seven steps are described below.

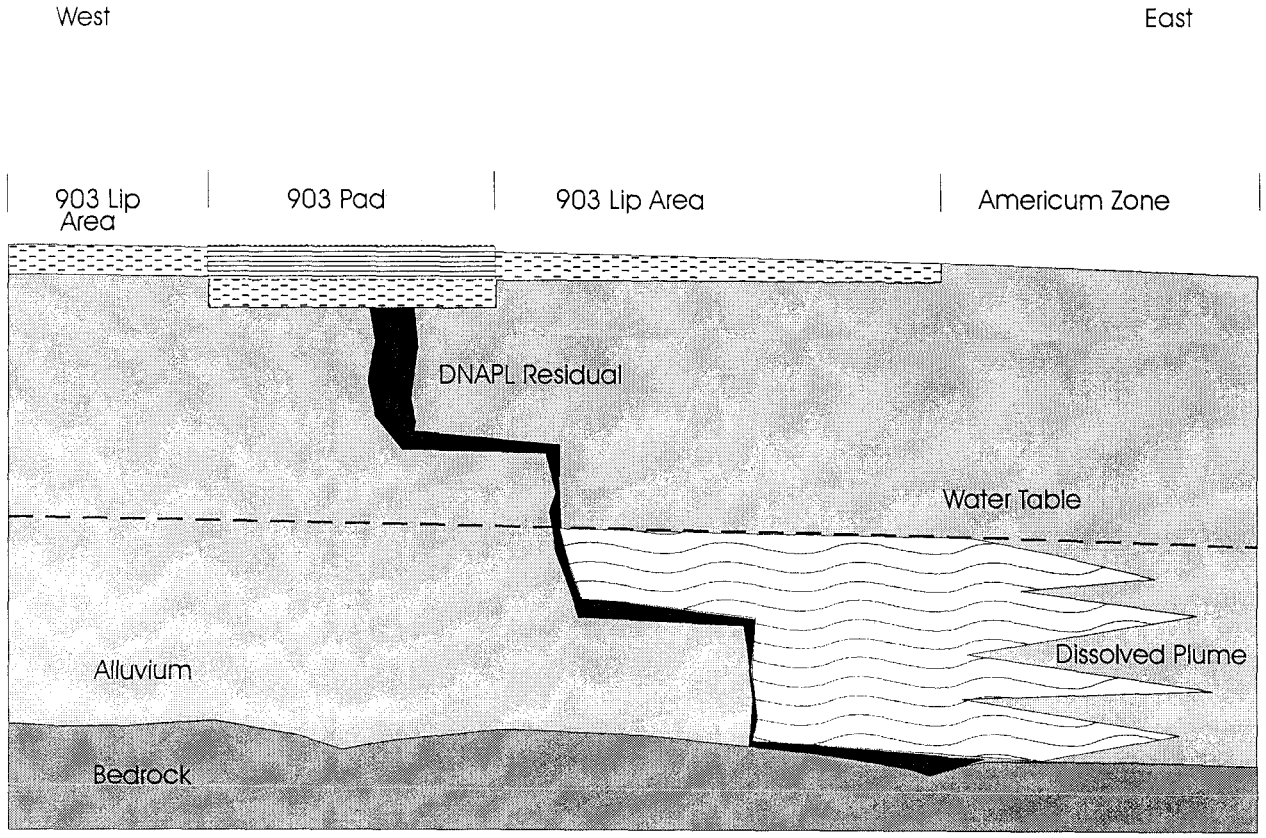
2.1 State the Problem

Surface Soils

Previous investigations in the Lip Area and Americium Zone have revealed radiological contamination in surface soils exceeding RFCA Tier I action levels triggering an action. The exposure area (EA) of previous investigations were 2.5- and 10-acre plots. The purpose of this characterization effort is to further refine the volume of soils exceeding RFCA Tier I action levels. An evaluation of a smaller EA is required to delineate soils not exceeding Tier I action levels therefore minimizing the area of soil requiring remediation.

Asphalt

Remediation of subsurface soils at the 903 Pad may require the removal and disposal of the asphalt comprising the 903 Pad. Low-level waste disposal facilities require that waste be characterized adequately to ensure that sample results represent the waste with at a 90% confidence level. No data, with the exception of a 903 Pad surface gamma survey (Rutherford, 1981), currently exists for the



not to scale

Legend

Base Coarse Fill

Asphalt

Sampling and Analysis Plan for the Site Charcterization at the 903 Drum Storage Area. 903 Lip Area and Americium Zone

Site Conceptual Model for DNAPL in Groundwater

Figure 1.2

asphalt. Preliminary analytical data will be required to design a statistically based sampling plan to meet the waste acceptance criteria of waste disposal facilities qualified to accept the waste. This SAP includes the collection of asphalt samples for preliminary waste characterization purposes.

Subsurface Soils

VOC Contamination - An analysis of groundwater data from the 903 Pad area indicates that a DNAPL may be present in subsurface soils below the 903 Pad. Existing VOC data collected from boreholes were compared to Tier I action levels and the results of the comparison indicate that no soil sample exceeds Tier I action levels. However, groundwater data indicate the potential for DNAPL. Additional information is required to determine the location and depth of VOC contamination for remedial alternative selection.

Radionuclide Contamination - Historical data from the 903 Pad indicate radionuclide activities above background in soils to 26 inches (66 cm) below the top of asphalt pad. A review of OU2 RFI/RI borehole data reveal no subsurface soil samples exceeded the Tier I action levels. However, radionuclides are suspected to have been transported with the solvents released at the site. Additional data are needed to determine the depth of radiological contamination for RFCA action level comparison. In addition, an evaluation of OU2 Phase II RFI/RI surface soil data indicated 5 Plots, each with an area from 2.5-acres which exceeded the RFCA Tier I action levels (RMRS, 1997). The soil samples used for the evaluation were collected to 0.64 and 2.0 inches in depth using the CDH and RF sampling methods, respectively. However, the depth of contamination has not been adequately characterized in these plots. These data are required to determine the volume of soils exceeding Tier I action levels to determine remedial alternatives.

Lastly, surface soils in the Lip Area have been disturbed by historical activities associated with stabilization of radiological contamination at the 903 Drum Storage Site. In 1969, contaminated surface soils in the Lip Area were graded into the 903 Drum Storage Site prior to covering the soils with an asphalt cap. Subsequent to grading the Lip Area, the surface was covered in 1970 with an imported basecoarse material to prevent wind erosion and transport of contaminated soils from the Lip Area. Contaminated soils may exist below the import material even though the OU2 Phase II

RFI/RI surface soil sampling programs did not detect plots exceeding Tier I action levels in this area. Fill material may also be present overlying potentially contaminated soils in area remediated in 1976 and 1978.

2.2 Identify the Decision

Soils

Decisions required to be made include:

- Where do concentrations/activities of contaminants/radionuclides in soils exceed RFCA Tier I Action Levels, and if they do to what spatial and vertical extent?
- Is VOC contamination present beneath and beyond the 903 Pad at levels exceeding Tier I action levels, and if it is where is it located?

Actions based on the decisions include the remediation of soils identified as exceeding Tier I action levels or subsequent remedial actions/no further action to be determined in the Buffer Zone OU ROD.

Asphalt

Decisions to be made on the asphalt are based on the identification of the waste type and to determine if the characterization data are sufficient to design a future sampling and analysis plan to meet the 90% confidence level requirement of waste disposal facilities' WACs.

2.3 Identify Inputs to the Decision

Soils

Inputs into the decision include radioanalytical and chemical results from surface and subsurface soil samples for RFCA Tier I action level comparison. These inputs can be used to determine characterization information.

Information to be determined from the additional investigation includes:

- The extent of organic contamination above Tier I action levels at the 903 Pad;
- The extent of radiological contamination above Tier I action levels beneath the 903 Pad;
- The extent of radiological contamination in natural soils underlying artificial fill material of the Lip Area; and
- The extent of radiological contamination in natural soils in the Americium Zone.

Asphalt

Inputs to the decision include waste characterization data, sufficient data to perform a background activity comparison. Decision rule is: If asphalt exceeds background activity for radionuclides it will be considered low level waste.

2.4 Define the Study Boundaries

Surface Soils

The study area has been selected from previous HPGe surveys and surface soil surveys, and includes surface soils in areas which have americium-241 activities in excess of 10 pCi/g. This study area includes five 2.5-acre surface soil plots which were identified as exceeding Tier I Action Levels for radionuclides through the data evaluation of the OU2 Phase II RFI/RI data. The study area also includes the 903 Pad, the Lip Area, and areas where previous surface soil remediation actions were performed in 1976, and 1978. Figure 2.1 shows the study area.

Asphalt Pad

The study boundaries include the entire 3.4-acre area of the asphalt pad.

Subsurface Soils

VOC Contamination - The study area has been determined to include an area of the 903 Pad where soils have historically shown staining and where high concentrations of VOC contamination exist in groundwater. When spilled on the ground surface and once the residual saturation value of soils is exceeded, the containment will move vertically in the vadose zone under the influence of gravity. If the contaminant is a DNAPL it will continue its migration downward though the saturated zone where sufficient product is present to displace water in the pore. Once the DNAPL reaches the aquatard, bedrock claystone at the 903 Pad site, it can potentially migrate laterally, even in the absence of a hydraulic gradient on the water table. The depth and lateral extent to which the suspected organic contamination has penetrated is unknown. The study boundary for the VOC-contamination is currently unknown, however, the extent will be investigated as long as contamination is suspected based on field observations, field organic vapor measurements, or analytical data results.

2.5 Develop a Decision Rule

Soils

The parameters of interest include the activity/concentrations of the following radionuclides/contaminants in surface and subsurface soils:

- Plutonium-239/240;
- Americium-241;
- Uranium-234;
- Uranium-235;
- Uranium-238; and
- VOCs (subsurface soils only).

Radionuclides - The decision level is based on activity of radionuclides in soils as defined in RFCA Tier I Soil action levels (DOE, 1996). If a mixture of radionuclide contaminants a, b, c are present in the soil with activities a_a, a_b, and a_c, and if the applicable action level of radionuclide in soil, as stated

in RFCA, is A_a, A_b, and A_c respectively, then the activity in the soil shall be limited so that the following relationship exists:

$$\frac{a_a}{A_a} + \frac{a_b}{A_b} + \frac{a_c}{A_c} \leq 1 \qquad \text{(Eq. 2.1)}$$

If the sum of ratios, as calculated in the above equation 2.1, exceeds 1 an evaluation, remedial action, and/or management action is triggered. Table 2.1 provides the Tier I action levels for radionuclides using the Buffer Zone hypothetical resident scenario.

TABLE 2.1 RFCA ALF TIER I SOIL ACTION LEVELS - RADIONUCLIDES

RADIONUCLIDE	ACTIVITY (pCi/g)
Americium-241	215
Plutonium-239/240	1429
Uranium-234	1738
Uranium-235	135
Uranium-238	586

If individual radionuclide activities in surface or subsurface soils exceed RFCA Tier I Action Levels, or the sum of their respective ratios exceed 1, action is required. If activities or the sum of ratios are below the Tier I action levels the soils will be addressed under the Buffer Zone OU record of decision (ROD).

Volatile Organic Compounds - The decision level is based on concentration of volatile organic compounds in soils as defined in RFCA ALF Subsurface Soil Action Levels. If the concentration of VOCs in soils exceed Tier I action levels for subsurface soils, an action must be taken. Table 2.2 provides the Tier I action levels for VOCs suspected to be present in soils at the 903 Pad.

TABLE 2.2 RFCA ALF TIER I SUBSURFACE SOIL ACTION LEVELS - SELECTED VOCs

COMPOUND	TIER I ACTION LEVEL (mg/kg)
Carbon Tetrachloride	110.00
Chloroform	152.00
1,2,-Dichloroethene (Total)	9.51
Methylene Chloride	5.77
Tetrachloroethene	11.5
Trichloroethene	9.27

Asphalt

If asphalt is removed, appropriate analyses must be performed to identify it's disposition. The parameters of interest in asphalt samples include the following radionuclides:

- Plutonium-239/240;
- Americium-241;
- Uranium-234;
- Uranium-235; and
- Uranium-238.

Radionuclides - Decision levels are based on the presence of radionuclides above background activities. If radionuclides above background are present in the asphalt it must be managed as a radioactive waste material.

2.6 Specify Limits on Decision Errors

Surface Soils

The HPGe investigation in this SAP was designed to provide 100% coverage of the study area. HPGe survey results will be field verified with the collection and analysis of surface soil samples. Soil samples will be collected and analyzed, the results will be compared to HPGe results using linear regression analysis. The goal of the soil sample results and HPGe results analysis is to obtain a correlation coefficient of 0.90. If an correlation coefficient of 0..90 is not obtained with the comparison of twenty soil sample the soil sampling program will be reevaluated.

Subsurface Soils

903 Pad - The radionuclide sampling program is based on the placement of 25 boreholes on a central-aligned grid of 80 feet over the 3.4 acre area of the 903 Pad. The decision error associated with this grid is there exists a 10% chance of not encountering a 90-foot diameter circular radiological hot spot beneath the 903 Pad. The VOC-contamination sampling program is based on authoritative sampling methods and is not statistically based.

Lip Area - No decision errors are associated with the Lip Area investigation. The subsurface sampling program is designed to characterize the depth of contamination and subsequently the volume of soil exceeding the Tier I action levels in the Lip Area.

Americium Zone - Like the Lip Area, no decision errors are associated with the Americium Zone investigation. The subsurface sampling program is designed to characterize the depth of contamination and subsequently the volume of soil exceeding the Tier I action levels in the Lip Area.

The QA/QC goals of the project shall include a 1 in 20 frequency for duplicate samples and equipment rinsates, a trip blank provided for each shipment of soils for VOC analysis. Relative percent difference (RPD) goals for soils shall be 40% for non-organics and and 30% for organics. The duplicated error ratio for radionuclides shall be 1.42. A completion goal for the project shall be

90%, that is 90% of the data collected, analyzed, and verified to be of acceptable quality for decision making. Twenty-five percent of the data shall undergo laboratory validation by a third party.

2.7 Optimize the Design for Obtaining Data

Soils

Radiological Investigation - Spatial. This SAP proposes using a linear regression double sampling technique to estimate the mean activity of plutonium-239/240, americium-241, and uranium-234, -235, -238 in surface soils. The double sampling method utilizes the fact that there is a strong linear correlation between americium-241 and plutonium-239/240 in surface soils. It is difficult to measure low levels of plutonium directly in the environment. Direct measurements of small concentrations require laboratory analyses which are not appropriate for a large study area proposed for this investigation.

The HPGe will be used to determine the average americium-241 activity over a FOV with a diameter of 39.4 feet and an area of 1,217 ft^2 when the detector is placed 1 meter over the ground surface. The linear relationship between HPGe measurements and americium-241 and plutonium-239/240 activities in soils will be verified by the collection of samples collected using the RF surface soil sampling technique. The soil sample results will be compared with results of the HPGe survey and a linear regression will be performed to estimate activities of RFCA-regulated radionuclides at all HPGe survey locations. These values will be compared to RFCA Tier I action levels and areas exceeding Tier I action levels will be targeted for further investigations including FIDLER surveys to determine if the activity is a result of a hot spot or if the activity is spread over the entire HPGe FOV.

A 100 pCi/g activity of americium-241 has been selected as an threshold value for the HPGe survey. This value has been calculated to represent 0.85 of the RFCA sum of ratios. This value was calculated by substituting activities into the sum of ratios equation (eq. 2.1) using the highest activities measured for uranium isotopes in surface soils from the OU2 Phase II RFI/RI (DOE, 1995) and using the americium-241/plutonium239 ratio to estimate plutonium-239/240 activities. The highest activities measured for uranium isotopes from the OU2 Phase II RFI/RI (DOE, 1995) CHD

sampling program are: 6.796 pCi/g for uranium-233/234; 2.110 for uranium-235; and 11.94 pCi/g for uranium-238. The americium-241/plutonium-239 ratio of 0.199, calculated from the OU2 Phase II RFI/RI (DOE, 1995) CHD surface soil sampling results, indicates that plutonium activity was 5.024 times that of americium-241. Values incorporated into Equation 2.1 are provided below:

Americuim-241	Plutonium-239	Uranium-233	Uranium-235	Uranium-238	Sum of Ratio

$$\frac{100}{215} + \frac{502.4}{1429} + \frac{6.79}{1738} + \frac{2.110}{135} + \frac{11.94}{586} = 0.85$$

Radiological Investigation - Vertical. Subsurface soil samples will be collected from areas in which surface soils are suspected to exceed Tier I action levels. The depth of contamination is required to calculate volumes of soils requiring remediation. In addition, subsurface soil samples will be collected in areas where p revious remedial actions have been performed to determine if the actions removed contaminated soil to below Tier I action levels. Areas requiring further characterization include:

- Surface soils exceeding the Tier I action levels as identified from the HPGe Survey;
- Basecoarse and natural soils beneath the 903 Pad; and
- Natural soils underlying artificial fill of the Lip Area.

The locations and number of samples required to be collected to characterize areas where surface soils exceed Tier I action levels will be determined after the results of the HPGe survey and associated soil samples are evaluated. The SAP will be modified to include additional subsurface soil sampling locations following the analysis of HPGe results.

Twenty-five shallow boreholes are proposed for the characterization of radionuclide contamination beneath the 903 Pad. Twenty-five boreholes over the 3.4-acre 903 Pad represents a borehole completed at each node of a 80 foot by 80 foot square grid. Based on this grid a 90-foot diameter hot spot or larger has no more that a 10% chance of not being hit.

A total of twenty-one boreholes are proposed to be completed over the Lip Area. A simple systemic design for sampling the area where artificial fill was placed in 1970 was selected. The design was selected by the placement of a borehole in each quadrant of a 2.5-acre plot. The grid represents the placement of a borehole at each node of a 165-foot by 165-foot central aligned square grid for a total of fourteen boreholes. This equates to one borehole for each 0.625-acre. Based on this grid, it is estimated that significant variations in soil activity over an area larger than a 185-foot diameter circular area have no more that a 10% chance of not being detected.

Additional boreholes are proposed to be completed in the Lip Area where surface soils were remediated in 1976 and 1978. One boring will be completed in the 1976 remediation area, and four boring will be completed in the1978 remediation area. The number of borehole proposed are not statistically based.

VOC Investigation - The study is designed to investigate the source of high concentrations of VOCs in groundwater monitoring wells at the 903 Pad, and at soil gas sampling locations at the southeast corner of the 903 Pad. The number and locations of the wells are based on authoritative (judgment) sampling and are not statistically based. The concentrations of specific VOCs in the groundwater monitoring wells samples were found to exceed 10% of the aqueous solubility of the compound and are suspected to exist as a DNAPL. The proposed investigation locates boreholes surrounding these groundwater monitoring wells.

One VOC investigation site is located at the southeast corner of the 903 Pad where historical photographs and soil gas surveys indicate a potential VOC release. Soil borings are proposed to be located east of existing Borehole 07191. Soil samples collected from Borehole 07191 did not detect elevated concentrations of VOCs. Soil borings proposed for the VOC investigation will be located directly where high VOC concentrations were detected in soil gas.

Asphalt

Asphalt samples from the 903 Pad will be collected to obtain a preliminary waste characterization profile of the material for disposal purposes, if necessary. The exact number of samples required to characterize the 903 Pad asphalt with at the 90% confidence level requires some information on the population. No analytical data exists for the asphalt, and preliminary data are required. Therefore, 9 asphalt samples will be collected from randomly selected locations over the 903 Pad. Sample locations shall be based on the grid spacing developed for the 903 Pad subsurface investigations. Nine sampling locations will be selected during the subsurface investigation for asphalt sample collection which will be submitted to the laboratory for radiochemical analysis. The results of these samples will be analyzed to determine the number of samples required to obtain a 90% confidence level.

3.0 SAMPLING AND ANALYSES - STRATEGY AND DESIGN

3.1 Radiological Contamination

The spatial and vertical extent of radiological contamination will be assessed within the proposed study area. Spatial extent of contamination will primarily be assessed using a non-intrusive HPGe field method. The HPGe method results will be verified and correlated to radiochemical data by the analysis of surface soil samples collected from selected HPGe measurement locations. The vertical extent of contamination will be assessed utilizing sampling methods employing Geoprobe® or conventional hollow-stem auger drilling techniques.

3.1.1 Surface Soil Investigation

The goal of the spatial investigation is to determine the total inventory (activity) of RFCA-regulated radionuclides above Tier I action levels within the study area. The EA has been defined to be single HPGe measurement with a FOV of 39.4 ft. (12 m) in diameter. This circular area represents 1,217 ft^2 or 2.8 x 10^{-2} acre. A double sampling technique will be employed to determine the total activity in surface soils in the EA. Plutonium 239/240 and americium-241 are expected to have a linear

relationship and a high coefficient of correlation. Americium-241 activities in surface soils can be determined with less expensive *in situ* methods rather than plutonium-239/240 which requires expensive radiochemical techniques performed in a laboratory. The Compendium of *In Situ* Radiological Methods and Applications at Rocky Flats Plants (EG&G, 1993) provides a detailed discussion on the physics of *in situ* measurement of radionuclides in the environment.

The first phase of the field program will consist of a surface soil HPGe survey using the truck and/or tripod-mounted detectors. When individual HPGe results are interpreted to exceed Tier I action levels a second surface soil survey technique will be employed. A FIDLER survey will be conducted over the HPGe's FOV (exceeding Tier I Action Levels) to determine if the exceedance is a result of an isolated hot spot or if the activity is consistent over the area.

3.1.1.1 Field Preparation

Reference stakes for the HPGe grid will be placed in the field before data collection activities are initiated. From these stakes, the HPGe survey grid will be laid out using tape and compass methods, at the spacing specified in Section 3.1.1.2. Each measurement point will be staked, flagged, and numbered for reference by the HPGe crew.

3.1.1.2 HPGe Survey

The HPGe survey will focus on the Lip Area and the Americium Zone. Figure 2.1 provides the extent of the study area. The study area includes all surface soils with elevated concentrations of plutonium-239/240 and/or americium-241 identified during the OU 2 RFI/RI including:

- 35 HPGe FOV plots which exhibit elevated (above 10 pCi/g) americium-241 activities;
- The area directly below the culvert which drains the 903 Pad and Lip Area where sediments are deposited during surface runoff events; and
- The five 2.5-acre plots which surface soils exceed RFCA Tier I action levels.

With a FOV of 1,217 ft^2, a square grid pattern having row and column spacing of 28 feet has been determined to provide 100 percent coverage for the field survey. This grid spacing translates to 144 HPGe measurements for complete coverage of a 2.5-acre area. Figure 3.1 shows the configuration of a typical HPGe survey grid. To obtain a FOV of 39.4 feet in diameter, a truck- and/or tripod-mounted detectors will be set at a one meter height above ground surface at each sampling point. Measurement count times will be determined in the field to insure a 95% confidence level of the HPGe to determine americum-241activities in soils to 100 pCi/g. Complete coverage of the survey area is estimated to require approximately 2,400 measurements.

HPGe measurements will be made at each survey location in accordance with Radiological Engineering Procedures 4-61100-REP-1401, Operation of Gamma Ray Spectroscopy Systems, and 4-R29-REP-1402, Routine Characterization of HPGe Detectors, to meet or exceed the specified threshold criteria of 100 pCi/g. For safety and logistical reasons, truck-mounted HPGe measurements will be limited to flat ground in the east and northeast Americium Zone areas. HPGe data from all instruments will be processed and converted to equivalent Pu-239/240 activity units, then plotted to permit preliminary field evaluation of surface soil Pu-239/240 activity trends.

3.1.1.3 FIDLER Surveys

In areas that HPGe measurements exceed the 100 pCi/g americium-241 threshold value, a follow-on FIDLER survey may be conducted. An evaluation of the nature of the exceedances will be conducted to determine if detailed FIDLER surveys are required. If it is determined that a FIDLER survey is needed, a grid with four-foot spacings will be staked in the field. While all available data will be used to determine whether a FIDLER survey is required, it is anticipated that these will only be conducted where there are not continuous, adjacent measurements above 100 pCi/g, americium-241 indicating the potential presence of isolated small areas with elevated actinide soil contamination.

FIDLER surveys will be conducted in accordance with Radiological Operating Instructions (ROI) Manual, 4-H58-ROI-06.6, Use of Bicron FIDLER. Readings will be taken and recorded for each of the four-foot grid nodes. When walking between grid nodes, the operators will slowly swing their

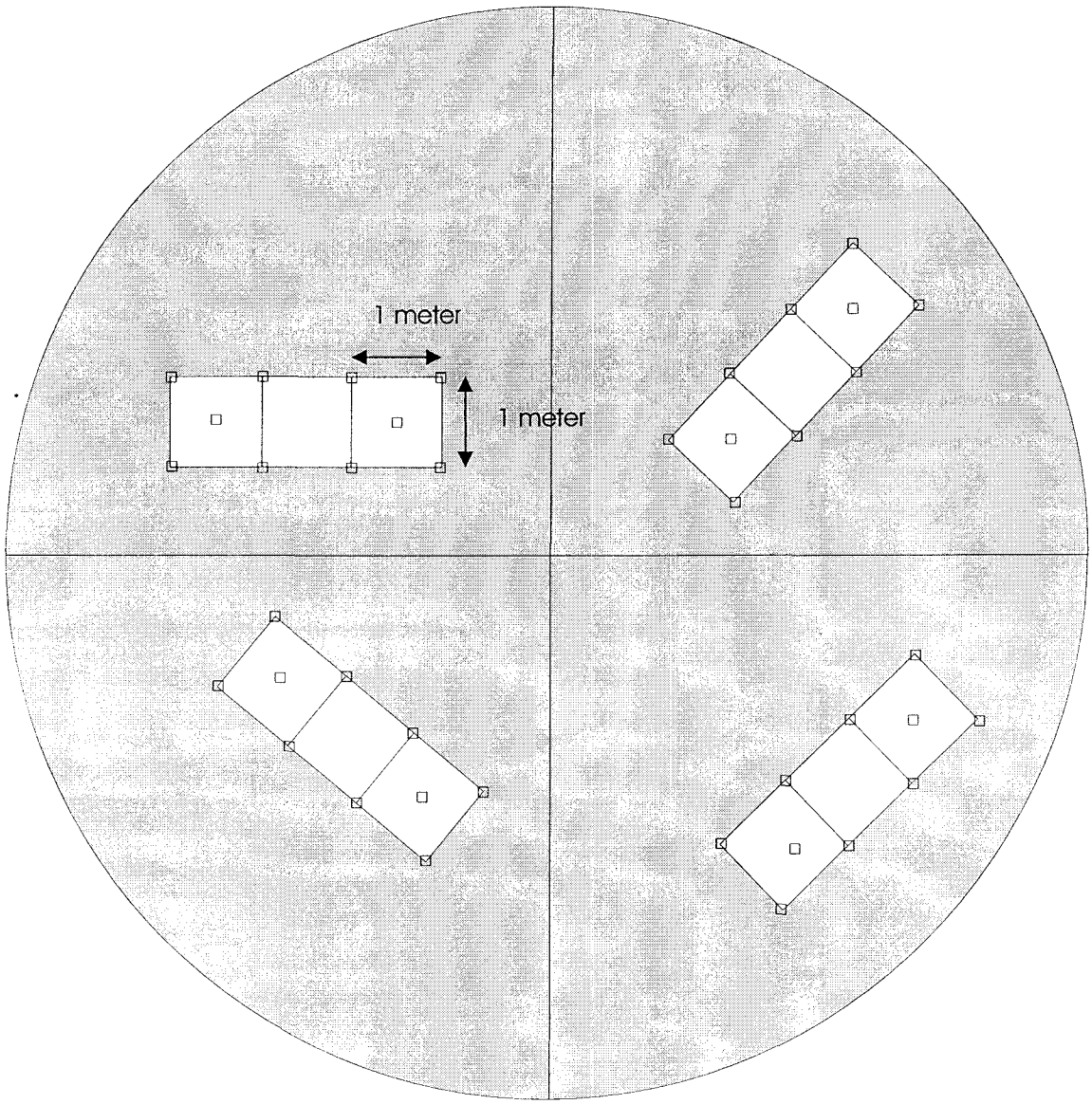
instruments. If an sharp increase in the reading is seen between grid nodes, the surrounding area will be investigated. All localized areas with higher reading will be flagged as potential hot spots. Potential hot spots and areas of higher concentrations identified during the hand-held FIDLER survey will then be staked, surveyed and labeled for future evaluation.

3.1.1.4 Surface Soil Samples

Surface soil samples will be collected using RF sampling method in an effort to correlate HPGe results to activities in surface soils. The RF sampling method involves the collection of 10 grab samples to depth of 2 inches over a 3 meter area. The grab samples are composited into a single sample and submitted to the laboratory for radiochemical analysis.

The purpose of the soil sampling method is to correlate the HPGe americium-241 measurements with americium-241 and plutonium-239/240 radioanalytical results. Twenty surface soil samples will be collected for comparison with HPGe measurements. A coefficient of correlation of 0.90 is the goal of the comparison. If the correlation goal of 0.90 is not reached after the collection of 20 soil samples the sampling strategy will be reevaluated.

The HPGe measurement represents the average surface soil activity over the 1,217 ft^2 FOV. To obtain a replicate soil sample, the area comprising the FOV will be subdivided into four equally-sized quadrants. A RF sample will be collected from each quadrant for a total of four sub-samples per HPGe measurement. The four samples will be composited into a single sample which will represent the physical average of surface soils over the 1,217 ft^2 area. Figure 3.2 provides the typical surface soil sampling scheme for HPGe correlation sampling. The results of the HPGe measurements and soil samples will be utilized to establish the correlation between the two methods to estimate activities at locations where only HPGe measurements are obtained. Table 3.1 provides the estimate number of HPGe measurements and surface soil samples required for the surface soil investigation.



12 meter field of view

Legend

Grab Sample Location

RF Sampling Grid

Sampling and Analysis Plan for the Site Charcterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

Typical Surface Soil Sampling Scheme

Figure 3.2

TABLE 3.1 SURFACE SOIL INVESTIGATION - FIELD PROGRAM

AREA	HPGe MEASUREMENTS (Estimated)	SURFACE SOIL SAMPLES[1] (Estimated)
903 Pad	0	0
Lip Areas	720	5
Americium Zone	1880	15

1 A maximum of twenty surface soil samples will collected to correlate HPGe measurements.

3.1.1.5 903 Pad Asphalt Samples

Asphalt samples from the 903 Pad will be collected to obtain a preliminary waste characterization data for disposal purposes. Nine asphalt samples will be collected from randomly selected locations over the 903 Pad. Random sampling techniques are appropriate methods for estimating the population mean, determination of total amount of contaminants present and the standard errors of these two estimates. Locations will be determined randomly based on the 903 Pad subsurface soil sampling grid. Table 3.2 provides the analytical program for asphalt samples.

TABLE 3.2 ASPHALT CHARACTERIZATION - ANALYTICAL PROGRAM

ANALYTICAL METHOD	ANALYTES	CONTAINER	PRESERVATIVE	HOLDING TIME
Radiological Screen	Gross Alpha/Gross Beta	40-ml glass jar	None	6 months
Alpha Spectroscopy	Plutonium-239/240, Americium-241, Uranium Isotopes	500-mL wide mouth glass or poly jar	None	6 months

3.1.2 Subsurface Soil Investigation

The depth of radiological contamination is required to calculate the volume of soil requiring remedial action. The depth of radiological contamination will be investigated at:

- The 903 Pad;
- The Lip Area; and
- Americium Zone where the HPGe has identified surface soils in excess to Tier I action levels.

3.2.2.1 VOC Investigation Boreholes

Samples will be collected utilizing Geoprobe® or conventional hollow-stem auguring techniques. Soil samples will be collected from boreholes completed in support of the VOC investigation and submitted to the laboratory for radiochemical analysis. The soil sample for radiochemical analysis will be collected immediately above the interval the VOC sample is collected.

3.1.2.2 903 Pad

Subsurface soil samples will be collected from artificial fill material and natural soils beneath the 903 Pad for radiochemical analysis. Soils will be continuously cored and sampled at 6-inch intervals. The samples will be screened for alpha and beta/gamma using a portable field instrument. Boreholes will be advanced a total depth of three feet below the top of asphalt or one foot past the depth where instrument background levels are reached, whichever is greater. A total of 25 boreholes are proposed for the 903 Pad radiological subsurface soil investigation. Figure 3.3 provides the locations of the proposed boreholes.

3.1.2.3 The Lip Area

Portions of the Lip Area have been disturbed during initial cleanup activities conducted in 1969 prior to the placement of the asphalt cap at the 903 Pad. These activities included the relocation (by grading) of "slightly contaminated" soils from the Lip Area to the 903 Pad for burial under the asphalt cap. The Lip Area was subsequently covered with artificial fill to prevent erosion of the remaining soils. Surface soil samples collected in the Lip Area during the OU2 Phase II RFI/RI program may not have encountered, and therefore characterized natural soils.

This sampling program is designed to collect samples of the artificial fill and the natural soils underlying the fill material. Portions of Plots 015, 016, 019, 020, 028, and 029 are located within the Lip Area. Each 2.5-acre plot will be divided into four equally sized quadrant representing 0.625-acre each. Portions of the 903 Pad are located in quadrants of Plots 015, 016, 019, 020 which will be characterized under the 903 Pad subsurface program. One soil boring will be placed in each quadrant for a total of fourteen boreholes In addition, three boreholes shall be complete within the windrow at the eastern boundary of the Lip Area. Samples will be collected utilizing Geoprobe® or conventional hollow-stem auguring techniques. Soils will be continuously cored and sampled at 6-inch intervals. The samples will be screened for alpha and beta/gamma using a portable ratemeter. Boreholes will be advanced a total depth of two feet below ground surface (bgs) or one foot past the depth the field instrument measurement reaches background levels, which ever is greater.

The Lip Area includes two additional areas where previous remedial actions have taken place. Remedial actions in 1976 and 1978 removed contaminated soils adjacent to the south side of the 903 Pad. Soils were removed adjacent to the Rocky Flat Alluvium pediment surface on the north hillside of Woman Creek. Analytical confirmation samples were not collected to confirm the conditions of soils prior to import soil placement.

3.1.2.4 Americium Zone

Subsurface soil samples will be collected in the Americium Zone to determine the depth of radiological contamination associated with the surface soil program. The number, location, and depth

of subsurface soil samples to be collected will be determined following the analysis of the HPGe survey data. The analysis of HPGe data will provide the area of surface soils exceeding Tier I action levels. Therefore, subsurface soil samples are required to characterize this area. Table 3.3 provides an estimate of the number of boreholes and samples required to complete the subsurface radiological investigation program.

TABLE 3.3 · SUBSURFACE SOIL RADIOLOGICAL INVESTIGATION - FIELD PROGRAM

AREA	BOREHOLES	SAMPLES	FREQUENCY
903 Pad	25-Radiological Investigation	150	6-inch Intervals
	8 - Initial VOC (est.)[1]	32(est.)	5-foot Intervals
	8 - Follow-up VOC (est.)[1]	32(est.)	5-foot Intervals
Lip Area	22-Radiological Investigation	88	6-inch Intervals
	3 Initial VOC (est.)[1]	12(est.)	5-foot Intervals
	3 Follow-up VOC (est.)[1]	12(est.)	5-foot Intervals
Americium Zone	TBD[2] - Additional borings based on HPGe results	TBD	6-inch Intervals

1 - Borehole samples collected for radiochemistry during VOC-contamination investigation .

(est.) - estimated

2 - TBD - To be determined following analysis of HPGe survey data

Borehole estimates for the subsurface radiological contamination investigation at the 903 Pad are based on the placement of 25 borings on an 80 by 80 foot grid over the 3.4-acre area of the asphalt pad. Estimates on the number of boreholes required to investigate the VOC contamination at the 903 Pad are based on the assumption of four initial and four follow-up boreholes required to characterize contamination detected in groundwater at two wells locations on the pad.

Borehole estimates for the subsurface radiological contamination investigation at the Lip Area are based on the placement of one borehole in each quadrant of a surface soil plot (2.5-acre plot) for a total of 14 boreholes. Estimates on the number of boreholes required for the Lip Area VOC

contamination investigation are based on the placement of three initial and three follow-up boreholes surrounding well 07191. Additional boreholes estimates are based on the placement of four boreholes in the area of 1976 surface soil remediation, one borehole placed in the 1978 surface soil remediation and three boreholes placed in the windrow.

The analytical program for soils generated in support of the subsurface soil radiological investigation is provided in Table 3.4.

TABLE 3.4 RADIOLOGICAL SUBSURFACE SOILS CHARACTERIZATION - ANALYTICAL PROGRAM

ANALYTICAL METHOD	ANALYTES	CONTAINER	PRESERVATIVE	HOLDING TIME
Radiological Screen	Gross Alpha/Gross Beta	40-ml glass jar	None	6 months
Alpha Spectroscopy	Plutonium-239/240, Americium-241, Uranium Isotopes	500-mL wide mouth glass or poly jar	None	6 months

3.2 VOC Investigation

Subsurface soil sampling at the 903 Pad will be implemented near existing groundwater monitoring wells 06691, and 08891 using a radial placement geometry with the well location serving as the center. Borehole 07191, which did not detect VOC contamination, will serve as the westernmost boring for the investigation of the soil gas anomaly at the southeast corner of the 903 Pad.

Initial boreholes will be located 20 feet from the respective well/borehole location being investigated. Figure 3.4 provides the locations of initial boreholes to be completed. Borehole locations will be spotted twenty feet to the north, south, east and west of locations 06691, and 08891. Borehole locations will be spotted twenty feet to the north, south, and east of borehole location 07191. Boreholes will be advanced from the ground or asphalt surface to a depth of one or two feet below the

top of bedrock. Samples will be collected at five foot intervals below ground surface (bgs), or at intervals where VOC are detected with field instrumentation. If VOCs are detected above ten ppm by field instrumentation, then the sampling grid will be extended an additional twenty feet to the north, south, east, and west of that location and additional samples will be collected for laboratory analysis.

If DNAPL is encountered, the follow-up boring step out distance will be reduced to 10 feet. This process will continue until the area of contamination above 10 ppm is defined. Follow-up borehole locations will be relocated in the field based on field results (i.e. if areas of high VOC contamination are found, additional borehole locations for soil sampling may be required to further delineate the extent of contamination). Table 3.5 provides an estimate of the number of boreholes and samples to be completed/collected by location.

TABLE 3.5 VOC SUBSURFACE SOIL CHARACTERIZATION FIELD PROGRAM

AREA	BOREHOLES	SAMPLES	FREQUENCY
903 Pad	8- Initial 8 -Follow-up (est.)	32 32 (est.)	5-foot Intervals
Lip Area	3- Initial 3 -Follow-up (est.)	12 12 (est.)	5-foot Intervals
Americium Zone	0	0	0

Table 3.6 provides the analytical program for samples collected for the VOC contamination investigation.

3.3 Sample/Data Collection and Handling

Prior to implementation of the field program procedure GT.25, Approval Process for Construction Activities on or Near Individual Hazardous Substance Sites (IHSSs) will be completed. Information collected in the field shall be handled according to FO.14, Field Data Management.

TABLE 3.6 VOC SUBSURFACE SOIL CHARACTERIZATION - ANALYTICAL PROGRAM

ANALYTICAL METHOD	ANALYTES	CONTAINER	PRESERVATIVE	HOLDING TIME
Radiological Screen	Gross Alpha/Gross Beta	40-ml glass jar	None	6 months
Alpha Spectroscopy	Plutonium-239/240, Americium-241, Uranium Isotopes	500-mL wide mouth glass or poly jar	None	6 months
SW-846 Method 8240B/8260A	Volatile Organic Compounds	120-mL capped core, 4 or 8-oz. wide mouth glass jar. Teflon lined closure.	Cool, 4° C	14 days
SW-846 Method 8240B/8260A (Trip Blanks)	Volatile Organic Compounds	3 x 40-mL glass, Teflon lined septa cap.	Cool, 4° C HCl pH<2	14 days

SW-846(EPA, 1986) Test Methods for Evaluation Solid Waste Physical /Chemical Methods

3.3.1 Sample/Data Collection

Surface Soils - HPGe measurements will be made at each survey location in accordance with Radiological Engineering Procedures (REP) 4-61100-REP-1401, Operation of Gamma Ray Spectroscopy Systems, and 4-R29-REP-1402, Routine Characterization of HPGe Detectors. FIDLER surveys will be conducted in accordance with ROI Manual, 4-H58-ROI-06.6, Use of Bicron FIDLER. Surface soil samples will be collected utilizing the RF method, as modified by this SAP, identified in GT.08, Surface Soil Sampling.

Subsurface Soils - The vertical extent of contamination shall be investigated through the completion of boreholes. Borehole locations shall be cleared according to GT.10, Borehole Clearing. Boreholes

will be completed by procedure GT.02, Drilling and Sampling Using Hollow-Stem Auger Techniques, or by GT.39, Push Subsurface Soil Sample. If hollow-stem auger techniques are selected, soil samples will be collected utilizing either continuous core auger sampling or continuous drive sampling, depending on which method provides the best percentage of core recovery. Boreholes will be logged according to procedure GT.01, Logging Alluvial and Bedrock Material. Boreholes will be abandoned by procedure GT.05, Plugging and Abandoning Boreholes.

3.3.2 Sample Handling

Sample collection and handling will follow Environmental Management Department (ERM) Operation Procedures Volume I Field Operations 5-21000-OPS-FO.13, Containerization, Preserving, Handling, and Shipping Soil and Water Samples. Samples will be transported to laboratories according to GT.25, Shipment of Radioactive Samples.

3.4 Equipment Decontamination/Waste Handling

Reusable sampling equipment will be decontaminated in accordance with EMD Operating procedure FO.03, Field Decontamination Procedures. Decontamination waters generated during the project shall be managed according to procedure FO.07, Handling of Decontamination Water and Wash Water. Drilling equipment shall be decontaminated between IHSSs using procedure FO.04, Decontamination of Equipment at Decontamination Facilities.

Drill cutting shall be handled according to procedure FO.08, Handling and Containerizing Drilling Fluids and Cuttings. Containers shall be labeled in compliance with FO.10, Receiving, Marking and Labeling Environmental Containers. Waste containers shall be managed by procedure FO.23, Management of Soil and Sediment Investigative Derived Materials (IDM). Personal protective equipment shall be disposed according to procedure FO.06, Handling of Person Protective Equipment.

4.0 PROJECT ORGANIZATION

Figure 4.1 illustrates the project organizational structure for the implementation of the 903 Drum Storage Site, 903 Lip Area, and Americium Zone SAP. With regard to this SAP, the RMRS Environmental Restoration Projects Group project manager will be the primary point of responsibility for maintaining data collection and management methods that are consistent with site operations. Other organizations assisting with the implementation of this project are: RMRS Groundwater Operations, RMRS Health and Safety, RMRS Quality Assurance, and Kaiser-Hill (K-H) Radiological Engineering, K-H Radiological Operations, and K-H Analytical Projects Office (APO).

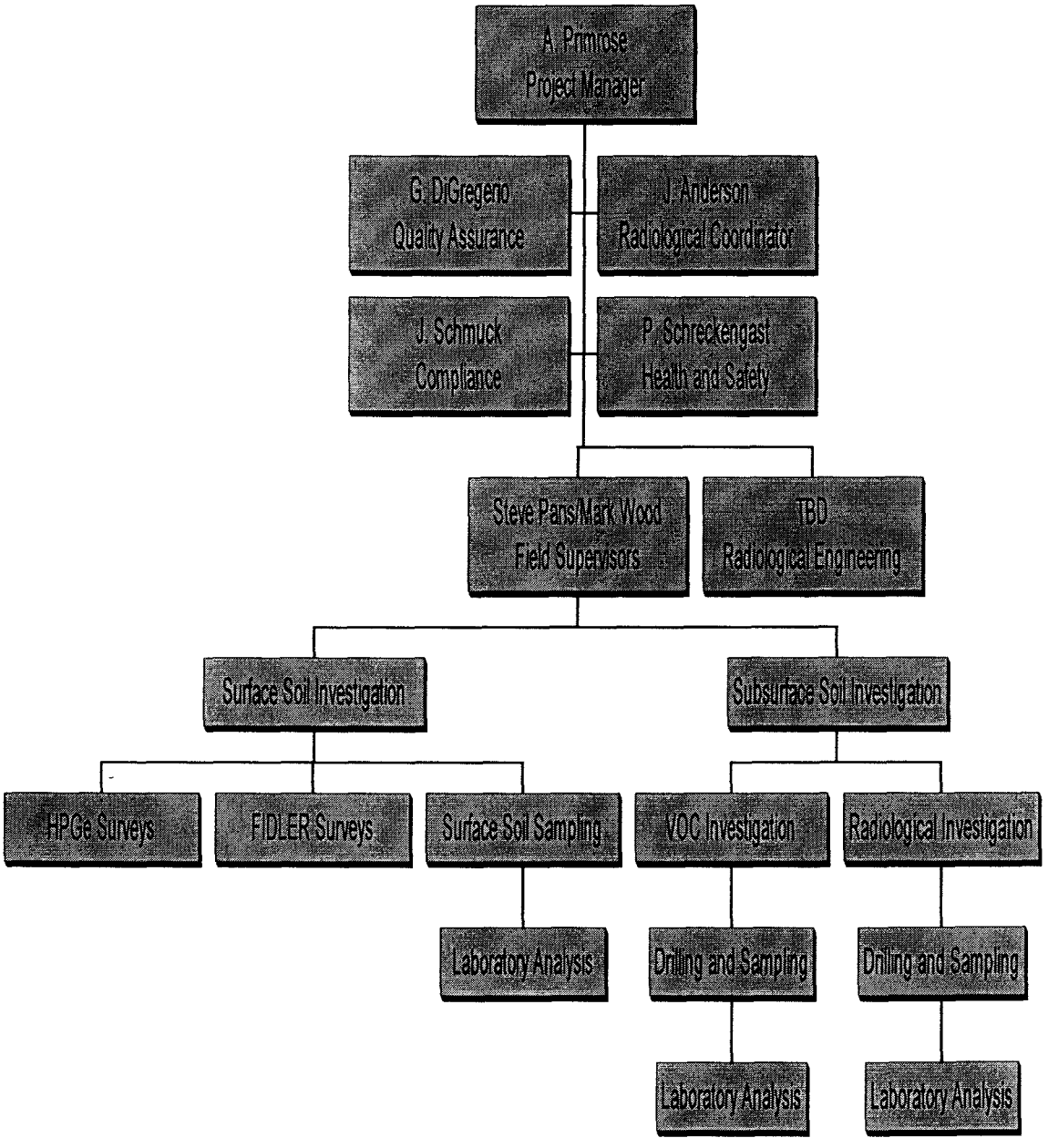
The sampling crew personnel will be responsible for field data collection, documentation, and transfer of samples for analysis. Field data collections will include sampling and obtaining screening results. Documentation will require detailed field logs and completing appropriate forms for data management and chain-of-custody shipment. The sampling crew will coordinate sample shipment for on-site and off-site analyses through the APO personnel. The sampling manager is responsible for verifying that chain-of-custody documents are complete and accurate before the samples are shipped to the analytical laboratories.

5.0 QUALITY ASSURANCE

Quality Assurance (QA) objectives pertaining to RMRS programs, DOE data management practices, and EPA guidelines will be applied. The project manager will be in direct contact with the QA officer to identify and correct issues with quality affecting potential discrepancies.

Field sampling quality control will be conducted to ensure that data generated from all samples collected in the field for laboratory analysis represent the actual conditions in the field. The confidence level of the data will be maintained by taking duplicate samples, equipment rinsate samples, and trip blanks. Duplicate samples will be collected on a frequency of one duplicate sample for every twenty real samples. Rinsate samples will be generated at a frequency of one rinsate sample

FIGURE 4.1
903 PAD, 903 LIP AREA, AND AMERICIUM ZONE
SAMPLING AND ANALYSIS PLAN
ORGANIZATIONAL CHART



for every 20 real samples collected. Trip blanks will accompany each shipment of VOC samples generated for the project. Trip blanks will not be required for samples shipped for radiochemical analysis only. Data validation will be performed on 25% of the laboratory data according to the Rocky Flats Analytical Projects Office (APO), Analytical Services Performance Assurance Group procedures. Table 5.1 provides the QA/QC samples and frequency requirements of QA sample generation.

TABLE 5.1. QA/QC SAMPLE TYPE, FREQUENCY, AND QUANITY

SAMPLE TYPE	FREQUENCY	COMMENTS	QUANITY (estimated)
Duplicate	One duplicate for each twenty real samples		100
Rinse Blank	One rinse blank for each twenty real samples	To be performed with reusable sampling equipment following decontamination procedures	100
Trip Blank	One trip blank per shipping container	VOC analysis shipments only	25

Analytical data that is collected in support of the of the 903 Pad SAP will be evaluated using the guidance developed by the Rocky Flats Administrative Procedure 2-G32-ER-ADM-08.02, Evaluation of ERM Data for Usability in Final Reports. This procedure establishes the guidelines for evaluating analytical data with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters.

A definition of PARCC parameters and the specific applications to the investigation are as follows:

Precision

A quantitative measure of data quality that refers to the reproducibility or degree of agreement among replicate or duplicate measurements of a parameter. The closer the numerical values of the measurements are to each other, the lower the relative percent difference and the greater the precision. The relative percent difference (RPD) for results of duplicate and replicate samples will be tabulated according to matrix and analytical suites to compare for compliance with established precision DQOs. A 30% or less RPD is the goals for organic analyses and a 40% or less RPD is the goal for non-organics. Deficiencies will be noted, and if necessary, additional sampling and analysis may be conducted.

Accuracy

A quantitative measure of data quality that refers to the degree of difference between measured or calculated values and the true value of a parameter. The closer the measurement to the true value, the more accurate the measurement.

The actual analytical method and detection limits will be compared with the required analytical method and detection limits for VOCs and radionuclides to assess the DQO compliance for accuracy. If necessary, additional sampling and analysis will be conducted.

Representativeness

A qualitative characteristic of data quality defined by the degree to which the data absolutely and exactly represent the characteristics of a population. Reproducibility is accomplished by obtaining an adequate number of samples from appropriate spatial locations within the medium of interest.

The actual sample types and quantities will be compared with those stated in the SAP or other related documents and organized by media type and analytical suite. Deviation from the required and actual parameters will be justified, and if necessary, additional samples will be collected and analyzed.

Completeness

A quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. A completeness goal of 90% has been set for this SAP.

Real samples and QC samples will be reviewed for the data usability and achievement of internal DQO usability goals. If sample data cannot be used, the non-compliance will be justified, and if necessary, additional sample collection and analysis will be performed.

Comparability

A qualitative measure defined by the confidence with which one data set can be compared to another. Statistical tests may be used for quantitative comparison between sample sets (populations). At minimum, the project data sets will be compared against other real data sets (as appropriate) and background data. This is necessary to demonstrate compliance with DQO specifications and identify deficiencies. Deficiencies will be justified, and if necessary, additional sample collection and analysis will be conducted. Quantitative values for PARCC parameters for the project are provide in Table 5.2

Laboratory validation shall be performed on 25% of the characterization data collected in support of this project. Data usability shall be performed on laboratory validated data according to procedure 2-G32-ER-ADM-08.02, Evaluation of ERM Data for Usability in Final Reports.

TABLE 5.2 PARCC PARAMETER SUMMARY

PARCC	RADIONUCLIDES	NON-RADIONUCLIDES
Precision	Duplicate Error Ratio $\leq$ 1.42	RPD $\leq$ 30% for Organics RPD $\leq$ 40% for Non-Organics
Accuracy	Detection Limits per method and APO Laboratory SOW	Comparison of Laboratory Control Sample Results with Real Sample Results
Representativeness	Based on SOPs and Work Plan	Based on SOPs and Work Plan
Comparability	Based on SOPs and Work Plan	Based on SOPs and Work Plan
Completeness	90% Useable	90% Useable

6.0 SCHEDULE

To be incorporated at a later date.

7.0 REFERENCES

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Sampling and Analysis Plan for the Site Characterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

Study Area

Figure 2-1

PT013 PT017 PT026 PT032 PT044 PT053 PT061 PT066 PT072

PT014 PT018 PT027 PT033 PT045 PT054 PT062 PT067 PT073

PT015 PT019 PT028 PT034 PT046 PT055

903 PAD

PT016 PT020 PT029 PT035 PT047

Survey Boundary

GPS Survey Point
Orgin of grid

903 Pad Area Lip Area

PT021 Culvert PT030 PT036 PT048

PT010 PT056 PT068

PT022 PT031 PT037 PT049

Explanation

- HPGe 150 foot FOV Circles (above 10pCi/g Am-241)
- Plots above Tier I Action Levels
- Proposed GPS Survey Point
- 1976 Soil Removal Area (approx)
- 1978 Soil Removal Area (approx)
- 1970 Soil Fill Area
- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
HPGe data from Ron Reisner, Gamma Survey Group, Safeguard Measurements, EG&G Rocky Flats, Inc. June 1994

Scale = 1 : 2760
1 inch represents 230 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

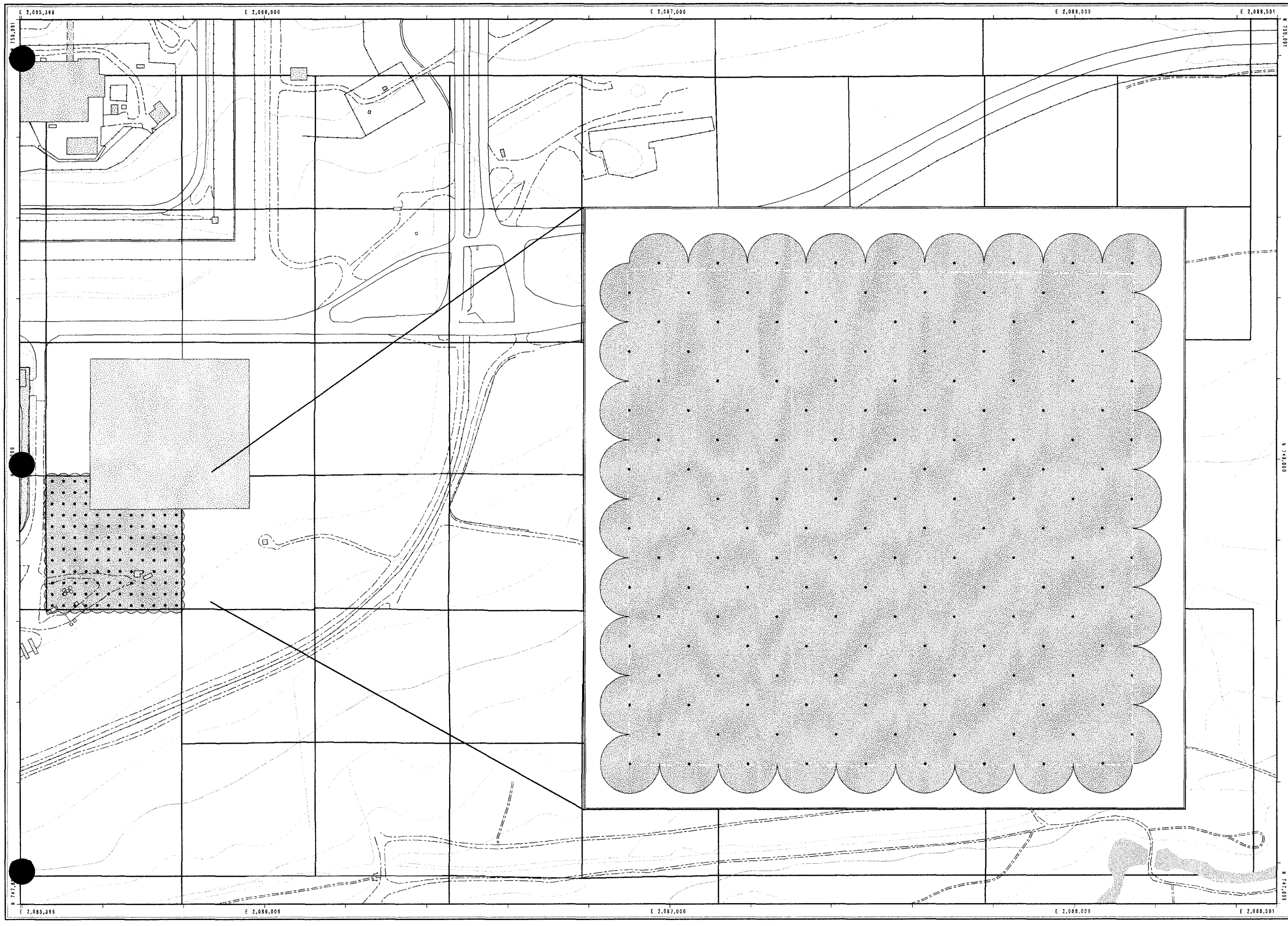
MAP ID: 97-0147 September 11, 1997

igis2/projects/hp97870147/fig3-hpge

Sampling and Analysis Plan for the Site Characterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

Typical HPGe Survey Grid

Figure 3-1



EXPLANATION

- Surface Soil Sampling Plot
- HPGe Measurement Field of View
- HPGe Survey Location

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. USE Topology (contours) were derived from digital elevation model (DEM) data by Merrie K (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was capture by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at 10 (?) meter resolution. The DEM post-processing performed by MK, Winter 1997.

Scale = 1 : 2840
1 inch represents approximately 237 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 97-0149 September 11, 1997

/gis1/projects/fy97/97-0149/hpge-loc.aml

Sampling and Analysis Plan for the Site Characterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

Radiological Subsurface Sampling Locations

Figure 3-3

PT013 PT017 PT026 PT032 PT044 PT053

PT014 PT018 PT027 PT033 PT045 PT054

PT015 PT019 PT028 PT034 PT046 PT055

PT016 PT020 PT029 PT035 PT047

PT021 PT030 PT036 PT048

PT010 PT056

E 2,085,383 E 2,086,000 E 2,086,700 E 2,087,400 E 2,087,532

N 749,086 N 749,700 N 749,000 N 748,243

EXPLANATION

- 5 ft elevation contour
- 1976 Soil Removal Area (approx)
- 1978 Soil Removal Area (approx)
- 1970 Soil Fill Area
- 903 Pad Lip Area Boreholes
- 903 Pad Boreholes

Standard Map Features

- Buildings
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Paved roads
- Dirt roads

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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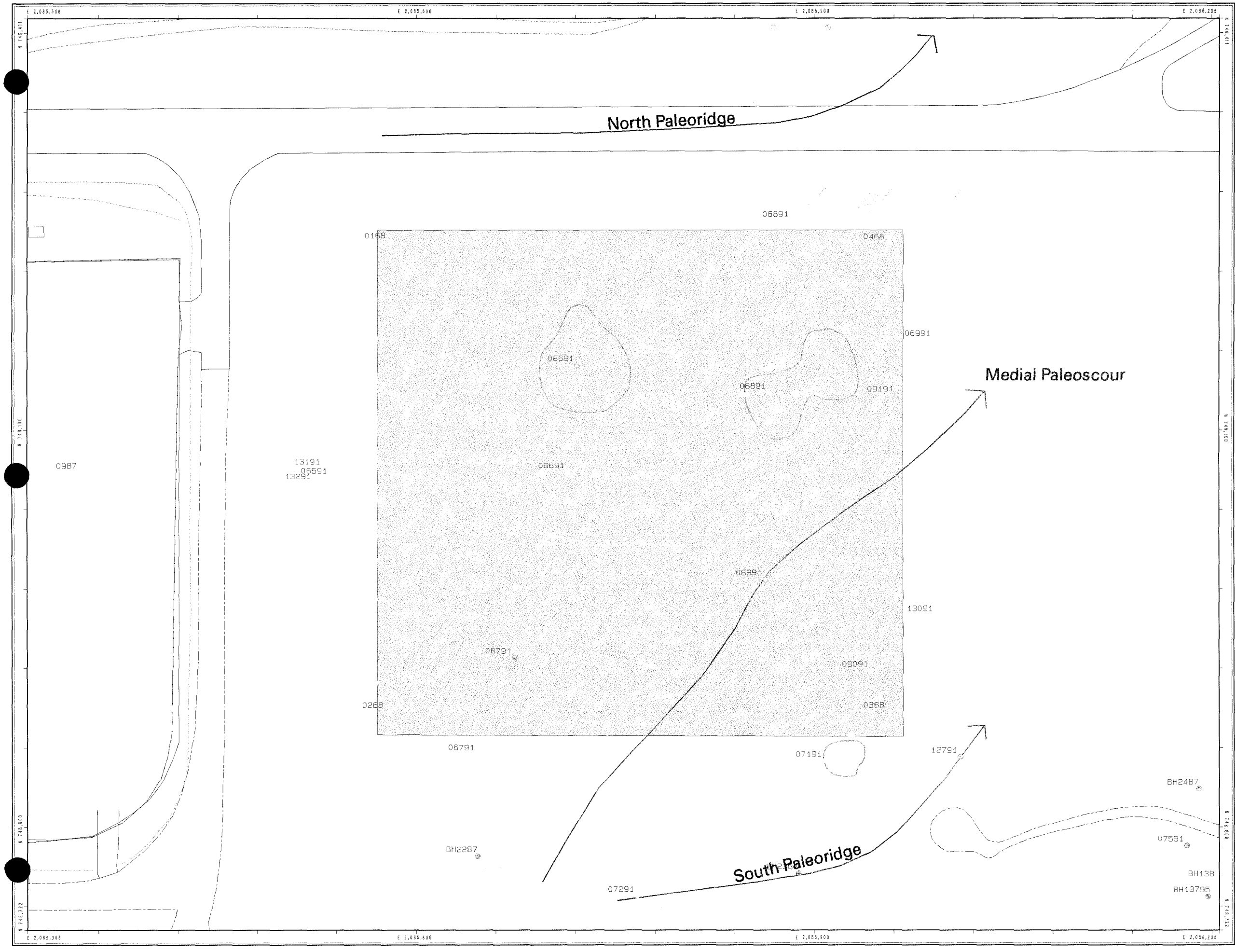
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 97-0149

September 11, 1997

/gis2/projects/fy97/97-0149/rad-loc.aml



Sampling and Analysis Plan for the Site Characterization at the 903 Drum Storage Area, 903 Lip Area and Americium Zone

VOC Investigation Borehole Location Map

Figure 3-4

EXPLANATION

- Proposed Boreholes
- Groundwater Monitoring Well
  Location Code-left
  Top of Bedrock Elev.-right
- Borehole
  Location Code-left
  Top of Bedrock Elev.-right
- Top of Bedrock Elevation Contours
- Soil Gas Concentrations > 100 ppm
- Paleotopograhic Trends
- Individual Hazardous Substance Site (IHSS 112)

Standard Map Features

- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

Scale = 1 : 840
1 inch represents 70 feet

25 0 50 100ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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September 11, 1997

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